APPARATUS AND METHOD FOR DETECTING AND CORRECTING A CORRUPTED BROADCAST TIME CODE

FIELD OF THE INVENTION

[0001] The invention relates generally to audience measurement systems, and more specifically, to an audience measurement apparatus that extracts time codes from a broadcast signal and then detects and corrects the time codes that are corrupted or erroneous.

BACKGROUND OF THE INVENTION

[0002] Ancillary identification codes are often added to broadcast radio and television programs for the purpose of enabling audience measurement. The ancillary identification codes, which are added at the time of program broadcast or creation, are subsequently accessed at a signal reception site to identify a program being viewed or heard at the signal reception site and for identifying the time at which the program is being viewed/heard. Systems for encoding video signals with ancillary identification codes have been in widespread use for decades. For examples of such systems refer to U.S. Patent No. 5,425,100 to Thomas et al., incorporated herein by reference. Many of the video encoding systems are designed to take advantage of the rigid, periodic timing that is characteristic of video signals by adding the ancillary code at periodic intervals in one of the lines of the vertical blanking interval of a television signal. In contrast, audio encoding systems have become feasible more recently because of the greater difficulty in hiding a code in an audio signal that lacks the rigid, periodic timing of a video signal. Specifically, coding cannot be masked during periods of program silence such that the code cannot be inserted at regular intervals when one or more of the intervals coincide with periods of silence. As a result, audio encoding systems typically do not add identification codes to a program at strictly periodic intervals.

[0003] To enable audience measurement, conventional broadcast identification codes begin with a synchronization or start-of-message field which allows a decoder to detect and lock onto the code, followed by a source identification (SID) field that identifies the source of the broadcast program. A time code field containing a characteristic time, such as a time of initial

dissemination of the broadcast from a network feed site to affiliated local stations, follows the SID field. Other fields may contain additional data.

[0004] A household site selected for audience measurement may decode a broadcast program signal to obtain the time codes and SIDs embedded therein. The time codes and SIDs are stored at the household site and subsequently transmitted to a central facility for reconciliation with an activity log that identifies the broadcast activity of a set of identified sources relative to a set of time codes. Thus, the time codes and SIDs received from a household site are compared to the activity log to identify the programs that have been viewed/heard at the household site.

[0005] However, the time codes extracted from the time code fields may be insufficient to enable identification of the time at which a program was viewed. Specifically, a delay may occur between a time that a program is encoded and a time when the same program is aired. Specifically, a network may encode a program with an SID unique to the network and with a time code equal to a standard clock time at which the program is initially distributed to affiliated local broadcasters by a satellite distribution system. The local broadcasters may either transmit the program immediately or store the program for hours or even days before airing the program. As a result, the time code embedded into the broadcast signal may have no relation to the actual local time at which the program is broadcast to viewers/listeners. Similarly, VCR technology permits viewers to record broadcast programs for later viewing of the recorded program off-air thereby also causing a shift between the time code embedded in the signal and the actual local clock time at which the program is viewed.

[0006] To compensate for the potential time delay that may occur between program encoding and program broadcast, the household site is additionally configured to record a set of read times that represent the actual, local times at which a broadcast program is being decoded for viewing/listening. More specifically, a read time is obtained from a local clock for each instance that a time code is detected/decoded in the programming signal being viewed/heard.

[0007] Unfortunately though, the data collection performed by an audience measurement system such as the household site described above is not error free. Specifically, decoder error

may occasionally cause one or more of the extracted identification code bits to be erroneously decoded. Generally, the probability that a time code bit will be incorrectly decoded increases monotonically with the temporal spacing of the code bit from the synchronization field. As a result, an accurately decoded SID does not guarantee that the associated time code bits have been decoded error free. In addition to decoder errors, the audience measurement system may encounter time intervals during which no code can be read -- either because none was added to the signal initially or because of signal transmission and distribution artifacts that degrade or accidentally erase the code. Poor signal reception may further exacerbate data collection errors.

[0008] In addition to the decoder errors discussed above, audience measurement systems designed to collect time codes from audio signals are also prone to data collection errors associated with using a microphone to receive the signal to be decoded. Specifically, despite dramatic advancements in the art that have enabled the inaudible burying of a time code within an audio signal and that have further enabled the retrieval of the same code at a reception site, a time code cannot be reliably extracted from an inevitably degraded signal picked up with a microphone.

[0009] Unfortunately, prior art systems designed to overcome such data collection errors are often computationally expensive and require complex processing equipment that can be costly and difficult to maintain and repair. For example, U.S. Patent No. 5,481,294 to Thomas et al. discloses a measurement system that uses a computationally expensive feature recognition system to back-up a code reading system.

[0010] As a result, there is a need in the art for an audience measurement system that overcomes one or more of the foregoing data collection errors.

SUMMARY OF THE INVENTION

[0011] In accordance with one aspect of the invention, an apparatus for processing audience measurement data includes a data input port for receiving a plurality of data records and a processor that is coupled to the data input port. The data records each contain a time code retrieved from a broadcast signal and a read time that corresponds to the time code. The read

times correspond to the time codes such that a set of first intervals between the read times are mathematically related to a corresponding set of second intervals between the time codes when the time codes are not corrupted. The processor determines the magnitudes of the first and second intervals, compares the magnitudes of the first and second intervals to identify one or more of the time codes that are corrupted and one or more of the time codes that are not corrupted, and to calculate a corrected time code for each time code that is corrupted.

[0012] In accordance with another aspect of the invention, a method for identifying and correcting one or more of a plurality of time codes extracted from a broadcast signal includes the step of recording a set of read times, each of which corresponds to one of the time codes, and each of which indicates when the corresponding time code was extracted from the broadcast signal. In addition, the method includes the steps of determining a set of first intervals between the read times, determining a set of second intervals between the time codes, each of the second intervals corresponding to one of the first intervals, comparing each of the first intervals to each corresponding second interval to determine whether each first interval and corresponding second interval are approximately equal. The method further includes identifying a subset of the second intervals that are not approximately equal to a corresponding subset of the first intervals based on the result of comparing, wherein each of the subset of second intervals is associated with at least one corrupted time code, and calculating a corrected time code for the corrupted time code.

[0013] In accordance with yet another aspect of the present invention, a storage medium stores software that detects and corrects one or more of a plurality of time codes extracted from a broadcast signal. The software is computer readable and includes instructions for causing a computer to receive a set of time codes and receive a set of read times that each correspond to one of the time codes, and that indicate when the corresponding time code was extracted from a broadcast signal. The software further includes instructions for causing a computer to calculate a set of first intervals between the read times, calculate a set of second intervals between the time codes, wherein each of the second intervals corresponds to one of said first intervals, compare each of the first intervals to each corresponding second interval to determine whether the first intervals are approximately equal to the corresponding second intervals. The software instructions further cause the computer to identify a subset of the second intervals that are not

approximately equal to a corresponding subset of the first intervals based on a result of the comparison, wherein the identified subset of second intervals are each associated with at least one corrupted time code, and cause the computer to calculate a corrected time code for the corrupted time code.

[0014] In accordance with still another aspect of the present invention, an apparatus for processing audience measurement data includes a means for receiving a plurality of time codes extracted from a broadcast signal, means for recording a plurality of read times, each corresponding to one of said time codes, a means for calculating a set of first intervals between the read times by determining a difference between two of the read times and a means for calculating a set of second intervals between the time codes, by determining a difference between two of the time codes. Each of the second intervals corresponds to one of the first intervals. The apparatus further includes a means for comparing each of the first intervals to each of the corresponding second intervals to determine whether one or more of the time codes are corrupted.

[0015] According to a further aspect of the present invention, the apparatus further includes a means for calculating a corrected time code for at least one of the two time codes used to calculate each of the subset of second intervals. The means for calculating a corrected time code may include a means for adding one of the first intervals to one of the time codes, wherein the first interval to be added to one of the time codes corresponds to one of the second intervals included in the subset of second intervals.

[0016] According to a still further aspect of the present invention, an apparatus for processing audience measurement data, such as a plurality of time codes and a plurality of read times that correspond to the time codes, includes an input port for receiving a plurality of data records and a processor. Each data record includes one of the time codes and the corresponding read time, and the processor determines when the time codes and the corresponding read times are time locked such that a first time code and a first read time included in a first data record have increased by an approximately equal amount relative to a second read time and a second time code included in a second data record, wherein the first data record is received at the input port later than the

second data record. The processor also determines when the time codes and the corresponding read times are not time locked such that a third time code and a third read time included in a third data record have not increased by an approximately equal amount relative to a fourth read time and a fourth time code included in a fourth data record. The third data record is received at the input port later than the fourth data record. The processor further determines when the time codes and the read times experience one or more transitions between being time locked and not being time locked and use the transitions to identify one or more of the time codes that are corrupted. In addition, the processor calculates one or more corrected time codes for the corrupted time codes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

[0018] FIGURE 1 is block diagram of a broadcast measuring system having a plurality of broadcast signal providers that transmit broadcast signals to a plurality of reception sites, each having an audience measuring apparatus according to one aspect of the invention.

[0019] FIGURE 2 is a block diagram of the audience measuring apparatus of FIGURE 1 and a consumer device for displaying or otherwise playing the broadcast signals according to another aspect of the invention.

[0020] FIGURE 3 is a table having a set of data records and a set of time intervals for use by the measuring apparatus of FIGURE 1.

[0021] FIGURES 4A and 4B include a flow chart of a method performed by the measuring apparatus of FIGURE 1 for identifying and correcting erroneous time codes according to yet another aspect of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] An apparatus for correcting a corrupted time code recovered from a broadcast signal receives a set of data records, each record containing a SID, a time code, and a read time. The apparatus detects the time codes that are corrupt by calculating and comparing time code intervals to read time intervals. More particularly, a time code interval is calculated between a first time code and a second time code and a read time interval is calculated between a first read time that corresponds to the first time code and a second read time that corresponds to the second time code. If the intervals are approximately equal, then the values may be validated. Conversely, if the intervals are not approximately equal, then one or both of the values are identified as being corrupt. When a corrupt time code, such as the second time code is identified, the apparatus calculates a corrected time code by adding the read time interval to the first time code. The corrected time code may then be used to validate other time codes that are subsequently extracted from the broadcast signal. The validated time code(s) may be transmitted in place of the erroneous time codes and with all of the collected data to a central facility for use in measuring the viewing habits of the inhabitants of a dwelling in which the apparatus is installed.

[0023] Referring now to drawings wherein like reference numerals represent like objects, and turning specifically to FIGURE 1, a broadcast measuring system 10 includes a plurality of broadcast signal providers 12 each transmitting a broadcast signal for reception at a plurality of consumer devices 14 installed in a plurality of reception sites such as consumer dwellings 16. The broadcast signal includes encoded broadcast identification codes and may be either an audio and/or video signal formatted for television and/or radio and/or a network such as the Internet. As a result, the broadcast signal providers 12 may be television or radio stations, and the consumer devices 14 may be televisions or radios. Alternatively, the broadcast signal may be any type of signal now known or later devised for transmitting broadcast information. Likewise, the consumer devices 14 may be implemented using any type of signal receiver. An audience measuring device 18 is coupled to each of the consumer devices 14 and stores the broadcast identification codes extracted from the broadcast signals that are received and displayed (or otherwise played) at the consumer device 14. The stored broadcast identification codes are later

transmitted via a public switched telephone network (PSTN) 20 to a central facility 22 where the codes are used to measure the viewing and/or listening habits of the consumers. Although described as being transmitted via the PSTN 20, the broadcast data may instead be transmitted via any number of communication methods including, for example, a cable television cable and a wireless telephone. Of course, the integrity of the data must be protected such that a wireless telephone may only be useful where wireless telephone communication is known to be extremely reliable.

[0024] Turning now to FIGURE 2, the consumer device 14 may be a television having a receiver 24 at which a broadcast signal is received. A tuner 26 causes the receiver 24 to tune to and receive a broadcast signal from any of the broadcast program providers 12. The received broadcast signal is subsequently transmitted to a conventional television circuit 28 that processes the signal for display at a television display (not shown). Alternatively, the signal may be routed to a video cassette recorder (not shown) for recording thereby enabling display at a later time. In addition to routing the received signal to the conventional television circuit 28, the received signal is simultaneously routed to a decoder 30 disposed in the audience measuring device 18. As shown in FIGURE 2, the signal may be routed to the decoder 30 via a hard wired connection or, an portion of the signal may instead be supplied first to a speaker 31 that processes and then plays the signal which is then detected at a microphone 33 that routes the detected signal to the decoder 30. As will be appreciated by one having ordinary skill in the art, due to the ability of the present invention to collect data provided in an audio signal, the present invention may be used to obtain audience measurement data in any number of broadcast media systems including radios, movie theaters, televisions and the Internet.

[0025] The decoder 30 extracts the broadcast identification codes from the broadcast signal and supplies the broadcast identification codes to a processor 32. The processor 32 may be implemented using a Texas Instruments digital signal processor model no. TMS 320VC33 and the decoder 30 may be implemented using software such as NAES II or NAES III that is executed by the processor 32.

[0026] The processor 32 supplements each record extracted from the broadcast signal by adding a read time obtained from a local clock 34. The format of each record may depend on the type of signal in which the record is embedded. For example, a record extracted from an audio signal may contain as many as fifty data bits. The read times are added to the records as each record is decoded and supplied to the processor 32 such that each read time indicates the time at which the corresponding record was decoded. The processor 32 processes the resulting broadcast identification records, each having a time code, a corresponding SID, and a read time added by the processor 32, and stores the processed data in a either of a memory device 35 or a temporary memory buffer 37, both of which may, but need not be, internal to the processor 32. At a later time, the processor 32 causes the stored records to be supplied to a data communication device 39 for transmission to the central data collection facility 22 at predetermined intervals or in response to a query. The communication device 39 may be implemented using, for example, a modem coupled to a telephone that converts the data to a format suitable for transmission via the PSTN 20. Alternatively, the communication device 39 may be implemented using any device that enables communication between the audience measurement apparatus and the central data collection facility.

[0027] Referring also to FIGURE 3, a table 36 stored in memory 35 contains a sequence of records 38 representative of the data records extracted by the decoder 30 and supplemented by the processor 32. For clarity, the SID and other data fields typically associated with the data records have been omitted from FIGURE 3. A first column of the table 36 contains a set of read times 40, as obtained from the local clock 34, and a third column contains a set of time codes 42 that have been extracted from the broadcast signal using the signal decoder 30. The time codes 42 are formatted as hexadecimal numbers representing a quantity of seconds that have elapsed since an epochal time. Each of the time codes 42 corresponds to a unique one of the read times 40 and is displayed in the same record 38 as the read time 40 with which it is uniquely associated.

[0028] For illustrative purposes, the table 36 also includes a second column labeled Δtr and a fourth column 24 labeled Δtc that contain a set of time intervals 44, 46 between read times 40 and between time codes 42, respectively. Specifically, the time interval 44 associated with the

most recently acquired record 38, i.e., the topmost record, is calculated by subtracting the read time 40 associated with the earliest acquired record, i.e., the bottomost record, from the read time 40 associated with the most recently acquired record. Likewise, the time code interval Δtc 46 associated with the most recently acquired record is calculated by subtracting the time code 42 associated with the earliest acquired record 38, from the time code 42 associated with the most recently acquired record 38.

[0029] Because the time codes 42 are encoded into the broadcast signal at the same rate that they are decoded from the broadcast signal, and because the rate at which the time codes 42 are decoded is represented by the read times 40, the time codes 42 will track the read times 40, provided that the time codes 42 are error free. More particularly, the intervals Δtr 44 between the read times 40 should approximately equal the intervals Δtc 46 between the time codes 42. When the time codes 42 track the read times 40 in this manner, the two data sets of read times and time codes are in a state of time lock, i.e., the data sets increment in a lock step fashion. When the read times 40 do not track the time codes 42, the data sets, tr and tc, are no longer time locked. Thus, when corresponding read time intervals 44 and time code intervals 46 are within an acceptable tolerance of each other, e.g., plus or minus one second, the two data sets of read times and time codes are time locked. When the corresponding read time and time code intervals 44, 46 are time locked, the time codes 42 associated with the time code intervals Δtc 46 are validated as being error free.

[0030] By way of example, the time code and the read time data sets are time-locked during the time period associated with the first and second records of table 36, wherein the bottommost record is the first record and the records are numbered in an ascending fashion such that the topmost record is the sixth record, because the read time interval, Δtr 44 between these records is approximately equal to the time code interval Δtc 46 associated with these records. In contrast, the data sets are not time-locked during the time period associated with the third record 38 because the corresponding read time interval Δtr 44 and time code interval Δtc 46 are not approximately equal. Specifically, a time code 40 associated with the third record 38 is earlier than the time code 42 of the previous, second record 38 thereby causing the read time interval 44 and time code interval 46 associated with the third record 38 to be mismatched or unequal. The

read time interval 44 is approximately equal to the corresponding time code interval 46 for the fourth, fifth and sixth records such that the data sets are again time locked.

[0031] Referring now to FIGURE 4A, a timestamp validation method 50 for detecting and correcting for such decoder errors may be implemented using, for example, a software program stored in the memory 35 and executed by the processor 32. The method 50 may begin at a step 52 where a data stack is created using time codes 42 that have been extracted from a broadcast signal. Specifically, the time codes 42 extracted from the signal are stacked in the order in which they were received such that the time code 42 received earliest is located at the bottom of the stack. Next, at a step 54, the earliest received time code is removed from the bottom of the stack and stored in the memory buffer 37. As is described in greater detail below, the steps of the method 50 operate to test the earliest received time code for validity. Thus, for purposes of describing the method 50, the earliest received time code is denoted tc_{test}.

[0032] Next at a series of steps 56, 58 and 60, a set of counters, COUNTER1 and COUNTER2 are initialized and COUNTER2 is incremented. Specifically, at the step 56, COUNTER1 is set equal to the number of time codes stored in the stack. At a later step in the method 50, COUNTER1 will be used to ensure that the earliest received time code, tc_{test}, has been compared against every time code stored in the stack At the step 58, the COUNTER2 is set equal to zero and then incremented by one at the step 60. The value stored in COUNTER2 represents the position, in the stack, of the time code being compared to the earliest time code tc_{test} wherein the bottommost time code in the stack is located in the first position, the time code immediately above the bottommost time code is located in the second position and so on.

[0033] After the step 60, the method 50 continues at a step 62 where COUNTER1 is compared to COUNTER2 to determine whether each of the time codes in the stack have been compared to the earliest time code, tc_{test}. Specifically, if COUNTER2 is greater than COUNTER1, then all of the time codes in the stack have been compared to tc_{test} and the method branches to a step 74 and steps subsequent thereto where tc_{test} is subjected to a set of final processing steps as is described in further detail below. If COUNTER2 is not greater than COUNTER1, then the method continues at a step 64 where the time code located in the stack position equal to the value of

COUNTER2 is copied from the stack for use in validating tc_{test}. For example, if COUNTER2 = 1, then the time code located in the first position of the stack is copied from the stack and stored in memory as tc_1. Next, at a block 66, the SID associated with tc_{test} is compared to the SID associated with tc_1. If the SID values do not match, i.e., $SID_{test} \neq SID_1$, then the time code tc_1 is not associated with the same broadcast program as tc_{test} such that tc_1 may not be used to validate tc_{test}. As a result, the method loops back to the step 60 and steps subsequent thereto where COUNTER2 is again incremented so that the time code located at the next position in the stack may be obtained for comparison to, and possible validation of, tc_{test}.

[0034] Referring also to FIGURE 4B which aligns with FIGURE 4A at connection points A, B, C and D, if the SID values match, i.e., $SID_{test} = SID_1$, then the time code, tc_1, is associated with the same broadcast program as tc_{test} such that tc_1 may be used to validate tc_{test}. As a result, the method 50 continues at a step 68 where time interval data is calculated. More particularly, at the step 68, an interval denoted Δtc between the time codes, tc_{test} and tc_1, is calculated and an interval denoted Δtr between a read time denoted tr_{test} that corresponds with the time code tc_{test} and a read time denoted tr_{test} that corresponds with tc_1.

[0035] Next, at a step 70, the interval Δtr is compared to the interval Δtc. If the interval Δtc is equal to the interval Δtr, within an allowable tolerance (TOL), i.e., $\Delta tc = \Delta tr \pm TOL$, then both Δtc_{test} and Δtc_1 are valid and are marked valid at a step 72. For example, the time codes Δtc_{test} and Δtc_1 may be marked valid by setting a validity flag associated with each value. Alternatively, any data association method may be used to indicate that the values Δtc_{test} and Δtc_1 are valid.

[0036] If instead the interval Δtc is not equal to the interval Δtr, within an allowable tolerance (TOL), i.e., $\Delta tc \neq \Delta tr \pm TOL$, then one or both of Δtc_{test} and Δtc_1 are invalid and the method branches back to the step 60 and the steps subsequent thereto, as described above. Likewise, after the values Δtc_{test} and Δtc_1 have been marked valid at the step 72, the method branches back to the step 60.

[0037] As described above, if, at the step 62, COUNTER2 is greater than COUNTER1, then all of the time codes in the stack have been compared to Δtc_1 and the method 50 continues at the step 74 where the processor 32 determines whether tc_{test} has been validated by the portion of the method 50 including the steps 60 – 72. If tc_{test} has not been validated, thereby indicating that tc_{test} is erroneous, then the method continues at the step 76 where tc_{test} is corrected. Specifically, at the step 76, SID_{test} is compared to an SID, denoted $SID_{previous}$, that corresponds to the most recently validated time code denoted $tc_{previous}$. The value of $tc_{previous}$ is equal to the value of the time code that was most recently removed from the stack for processing by the method 50 and that was validated during the most recent of the previous iterations of the method 50. If the SID values are equal, i.e., $SID_{test} = SID_{previous}$ thereby indicating that the time codes, tc_{test} and $tc_{previous}$, were extracted from the same broadcast program, then a read time interval $\Delta tr_{previous}$ between a read time denoted $tr_{previous}$ that corresponds to the time code, $tc_{previous}$, and the read time, tr_{test}, that corresponds to the time code tc_{test} is calculated at a step 78. At the step 78, the read time interval $\Delta tr_{previous}$ is also added to the value of $tc_{previous}$ to obtain a corrected value for the time code tc_{test} which is subsequently stored in a list of validated time codes, at a step 80, for later retrieval and usage in calculating corrected time codes as necessary. After storing the value of tc_{test}, the method branches back to the step 54 where the next time code value is extracted from the bottommost position in the stack and the method continues at the steps subsequent thereto as described above.

[0038] If at the step 74, the processor 32 determines that the value of tc_{test} has already been validated, then the method continues at the step 80 where the value of tc_{test} is stored for later usage as described above.

[0039] While the invention has been discussed in terms of preferred and specific embodiments, it should be appreciated by those of skill in the art that the invention is not so limited. For example, those having ordinary skill in the data processing arts will recognize that although the method 50 has been described as employing two separate memory devices 35, 37, the method could be carried out equally well with a single memory device. Moreover, it will be recognized that it is not necessary that the read time intervals used in the calculation be calculated between an earliest acquired read time value and all of the other read time values. Instead the

calculations may be performed using read time data associated with any size interval provided, of course, that the corresponding time code interval to which the read time interval is compared is calculated over the same interval.

[0040] The processor 32 may further be programmed to enable the transfer of the data values stored in the memory 35 to the central data collection facility 22. (See FIGURE 1). Specifically, at regular intervals, in response to a query from the central data collection facility 22 or when a predetermined amount of data has been collected, the processor 32 may cause the data to be transmitted to the communication device 39, and may cause the communication device 39 to transfer the data to the central collection facility 22 via the PSTN 20.

[0041] In addition, the technique used to calculate the corrected time code values need not be dependent upon the read time data and time code data returning to time lock. Instead, the read time data collected when the system was in an earlier state of time lock may be used to calculate a corrected time code value for a later-decoded, erroneous time code value.

[0042] Further, although the apparatus is described herein as having a processor, a decoder and a time clock, a set of memories and a device that enables communication with the central facility, one or more of the foregoing components may be replaced with one or more devices that perform equivalent functions. For example, the data processing performed by the processor may instead be performed using any combination of electronic circuitry adapted to implement the method of the present invention including, for example, an application specific integrated chip, or a complex programmable logic device. As a further example, the data processing may be performed by an electronic circuit containing components such as a comparator, an adder/subtractor and a set of suitable logic gates. Likewise, although the apparatus and the consumer device are described as being separate components, one or more of the components disposed in the apparatus may be disposed in the consumer device and vice versa.

[0043] Further, the present invention may be used to process audience measurement data broadcast from any source such as land-based television/radio broadcasters and satellite-based broadcast distribution sites. Moreover, the apparatus/method described herein may be used to

process data supplied in any broadcast signal format now known or later devised including video signals, audio signals, television signals, radio signals, and both hard-wired and wireless Internet signals.

[0044] Thus, the embodiments explained herein are provided by way of example, and there are numerous modifications, variations and other embodiments that may be employed that would still be within the scope of the present invention.